CLAIMS

1. A method of communicating between a first location and a second location, the method including the steps of: at the first location, generating output signals having an irregular component, and copying the output signals at least in part such that for each output signal, there is a pair of signal copies, the irregular component being common to each of the signal copies of a pair; transmitting, from the first location, each signal copy of a pair over a common communications link; at the second location, mixing data onto the irregular component of a signal copy for at least some of the pairs of signal copies; and, at the first location, receiving signal copies from the second location and, for pairs of received signal copies, combining the respective irregular components of the signal copies of a pair in order to extract therefrom data mixed at the second location.

2. A method as claimed in claim 1, wherein the source is an optical source, the output signals being optical signals.

3. A method as claimed in claim 1 or claim 2, wherein the mixing is carried out through the modulation of the irregular component.

4. A method as claimed in any of the preceding claims, wherein the irregular component is random or pseudo random.

5. A method as claimed in any of the preceding claims, wherein the output signal has a waveform, the irregular component being the phase of the waveform, the waveform having randomly occurring phase changes.

6. A method as claimed in claim 5, wherein the mixing occurs throughout the phase-modulation of the waveform.

7. A method as claimed in any of the preceding claims, wherein signal copies of a pair are transmitted over the common communications link with a delay relative to one another.

8. A method as claimed in any preceding claim, wherein signal copies are optical signals, the or a differential delay being caused at an unbalanced interferometer, the

interferometer having a first path and a second path, the transit time of the first path being longer than that of the second path, signal copies of a pair being caused to travel along a different respective path to one another.

9. A method as claimed in claim 8, wherein the interferometer has a first coupling stage which is coupled to the source, the coupling stage being arranged to channel one portion of the incoming radiation intensity from the source along one path, and another portion of the incoming radiation intensity along the other path, so as to form the first and second signal copies.

10. A method as claimed in claim 9, wherein the interferometer has a second coupling stage for combining radiation from the first and second paths, and for coupling the combined radiation to the common communications link.

11. A method as claimed in claim 10, wherein the signals returned from the second location are each channelled along the first and second paths by a second coupling stage, and wherein the so channelled signals are subsequently combined at the first coupling stage.

12. A method as claimed in any of the preceding claims, wherein the source is configured to produce a continuous signal stream.

13. A method as claimed in claim 12, wherein the output signals have predetermined respective positions in the signal stream.

14. A method as claimed in any of the preceding claims, wherein the signal copies are delayed relative to one another at the first location, and wherein at the second location, signals are mixed according to a burst mode protocol, in which protocol the time between bursts is larger than the duration of the differential delay.

15. A method as claimed in any of the preceding claims, wherein the signals returned from the second location to the first location are returned along the common communications link.

16. A method as claimed in any of the preceding claims, wherein signals are reflected by reflector means at the second location in order to return the signals to the first location.

17. A method as claimed in any of the preceding claims, wherein the signals are modulated at the second location.

18. A method as claimed in any preceding claim, including the step of monitoring the signals returned from the second location, so as to detect whether a physical disturbance in the communications link occurs.

19. A method as claimed in claim 5 or any of claims 6 to 18 when dependent on claim 4, wherein the waveform has an average phase-coherence time of less than 10 pico seconds.

20. A method as claimed in claim 19, wherein the phase-coherence time is less than 1 pico second.

21. A method as claimed in any preceding claim, wherein for each pair of out bound signal copies transmitted from the first location to the second location, one copy of delayed such that there is a leading copy and a trailing copy, there being a differential delay between the leading copy and the trailing copy, and, preferably, wherein for each pair of signal copies returned from the second location, the leading copy is delayed at the first location, such that when the two copies are combined, the differential delay is reduced to allow the copies to be combined substantially instep.

22. A method as claimed in any preceding claim, wherein to combine the signal copies of a pair, the signal copies are caused to interfere.

23. A method as claimed in claim 21, wherein the trailing copy of a signal pair is delayed at the first location by a delay stage, the leading copy of the pair in the return direction being delayed by the same delay stage in order to reduce the differential delay between the two copies.

24. A method of communicating over a data link, the method including the steps of: generating output signals having an irregular component; copying at least in part the output signals such that for each output signal, there is a pair of signal copies, the irregular component being common to each of the signal copies of a pair; transmitting at least one signal copy of each pair onto a common communications link; receiving, from a remote location, returned signal copies previously transmitted to the remote location, the irregular component of the returned signal copies having data mixed therewith; and, combining the received signal copy of a pair with the other signal copy of that pair, such that, in dependence on the combination of the respective irregular components of two signal copies of a pair, a data signal is generated, which data signal is indicative of data mixed remotely with the returned signal copy.

25. A method as claimed in claim 7, wherein the delay is varied, preferably randomly or pseudo randomly.

26. A method of communicating between a first location and a second location, the method including the steps of: at the first location, copying at least in part output signal received from a source such that for each output signal, there is a pair of signal copies, the irregular component being common to each of the signal copies of a pair; transmitting, from the first location, each signal copy of a pair over a common communications link; at the second location, applying data onto the irregular component of a signal copy of at least some of the pairs of signal copies; and, at the first location, receiving signal copies from the second location and, for each pair of signal copies, combining the respective irregular components of the signal copies from that pair in order to extract therefrom data mixed at the second location.

27. A method of monitoring a transmission link to detect a physical disturbance in the link, the method including the steps of: copying at least in part output signals such that for each output signal, there is a pair of signal copies; transmitting at least one signal copy of each pair onto a common communications link; receiving, from a remote location, returned signal copies previously transmitted to the remote location; and, combining the received signal copy of a pair with the other signal copy of that pair, such that, in dependence on the combination of the two signal copies of a pair, a combination signal is generated; in dependence on at least one characteristic of the combination signal, generating a disturbance alert signal.

28. A method as claimed in any preceding claim, wherein for each pair of outbound signal copies transmitted from the first location to the second location, one copy of delayed such that there is a leading copy and a trailing copy, there being a differential delay between the leading copy and the trailing copy, the irregular component having an irregularity on a time scale that is less than the differential delay.

29. A method as claimed in claim 28, wherein the ratio of the relative delay and the time scale of the irregularity is at least 10^5, preferably at least 10^7

30. A method as claimed in claim 28 or 29, wherein the data is applied onto the irregular component such that between periods when data is being applied, there are quiet intervals during which data is not being applied.

31. A method as claimed in claim 30, wherein the duration of the quiet periods is greater than the differential delay.

32. A method as claimed in claim 30 or 31, wherein the periods during which data is applied are each shorter than the differential delay.

33. A method as claimed in any preceding claim when dependent on claim 8, wherein the first path and the second path have a path difference of at least 1 km, preferably at least 8 km, yet more preferably at least 10 km.

34. A communications apparatus having: a source for generating output signals having an irregular component; a copying stage for copying at least in part the signals from the source such that for each output signal, there is a pair of signal copies, the irregular component being common to each signal copy of a pair; a transmission stage for transmitting the signal copies of a pair onto a common communications link; a receiving stage for receiving signal copies returned from a remote location, the irregular component of at least some of the returned signals having data mixed therewith; a combination stage for causing the respective irregular components of the returned signals to combine; and, data processing means coupled to the combination stage, the data processing means being configured to generate in use a data signal in dependence on a combination of the of the returned signals of a pair, the data signal being representative of data, if any, carried by a returned signal.

35. Communications apparatus as claimed in claim 34, wherein a coupling stage is provided which acts on the one hand as the copying stage for signals travelling in an outbound direction towards the common communications line, and on the other hand, as the combination stage for signals travelling in a return direction from the common communications link.

36. Communications apparatus as claimed in claim 35, wherein the copying stage and the transmission stage are connected by a first path and a second path, each of the first and second paths extending between the copying stage and the transmission stage, the transit time associated with the first path being greater than the transit time associated with the second path.

37. Communications apparatus as claimed in claim 36, wherein the paths are formed by an unbalanced interferometer, preferably an unbalanced Mach Zhender interferometer.

38. Communications apparatus as claimed in any of claims 34 to 37, wherein the source is an optical source having a coherence time less than a differential delay associated with a first and second path.

39. Communication apparatus as claimed in claim 38, wherein the ratio of the differential delay and the coherence time of the source is at least 10^5, preferably at least 10^7.

40. A communication method for performing secure communication, comprising the steps of: transmitting towards a remote location signals that are time delayed relative to one another; applying data onto at least some of the time delayed signals at the remote location; receiving the time delayed signals returned from the remote location; and performing a function on the time delayed signals to extract the applied data, wherein the signals have an irregular component, preferably the phase, the irregularity of the component being on a time scale that smaller than the relative time delay.

41. A method as claimed in claim 40, wherein the ratio of the differential delay and the coherence time of the source is at least 10^5, preferably at least 10^7.

42. A method as claimed in claim 40 or 41 wherein the data is applied at the remote location such that between periods when data is being applied, there are quiet intervals during which data is not being applied.

43. A method as claimed in claim 42, wherein the duration of the quiet intervals is greater than the differential time delay.

44. A method as claimed in claim 42 or 43, wherein the periods during which data is applied are each shorter than the differential time delay.